Journal of the

Electrochemical Society

SEPTEMBER 1950 VOLUME 97 • NUMBER 9

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Published monthly by The Electrochemical Society, Inc., Mt. Royal and Guilford Aves., Baltimore 2, Md., combining the JOURNAL and TRANSACTIONS OF THE ELECTROCHEMICAL SOCIETY. Editorial Office: 235 W. 102nd St., New York 25, N. Y. Statements and opinions given in articles and papers in the JOURNAL OF THE ELECTROCHEMICAL SOCIETY are those of the contributors, and The Electrochemical Society assumes no responsibility for them. Subscription: $7.50 to members, $10.00 to nonmembers. Single copies $.75 to members, $1.00 to nonmembers. Copyright 1950 by The Electrochemical Society. Entered as second-class matter November 15, 1947, at the Post Office at Baltimore, Md., under the act of August 24, 1912.

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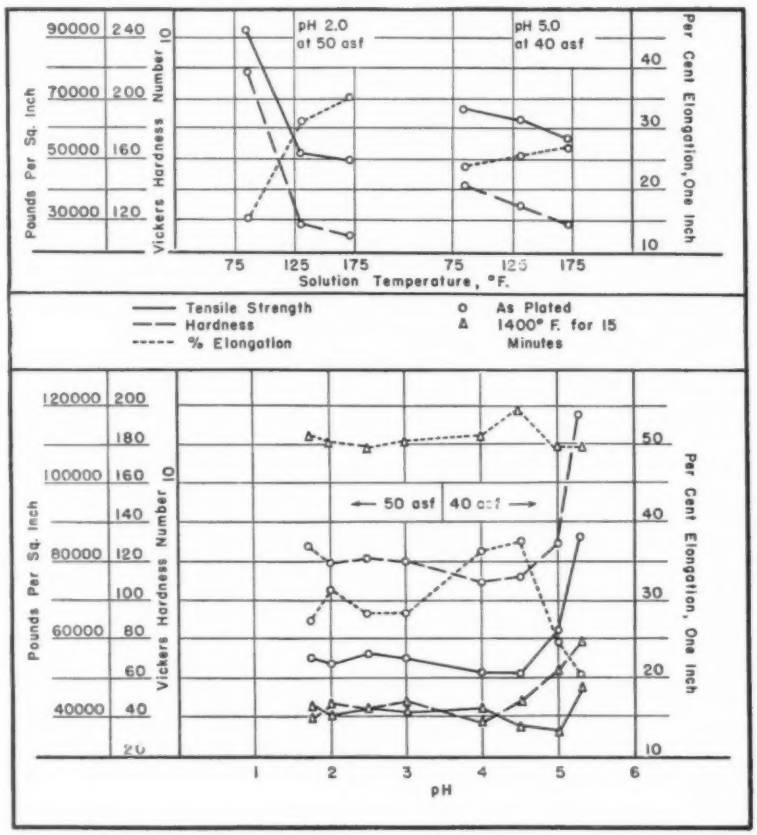

EFFECT OF pH

This wide range of properties warrants consideration of nickel for numerous applications. If you desire further information on this subject, reprints of an article, "Mechanical Properties of Nickel Deposits," which appeared in MONTHLY REVIEW for October 1947, and in PLATING for May 1948 are available upon request. The A.E.S. has sponsored an intensive investigation of the physical properties of nickel deposits at the Bureau of Standards. This material should be released in the near future.

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Editorial

Science, Foreign Relations, and Point Four

RECOGNITION of the importance of science in world affairs has led to the recommendation that a science office be established in the State Department at the policy level and that science staffs be attached to selected United States diplomatic missions abroad. The general objective of these steps as set forth in a comprehensive report prepared by Dr. L. V. Berkner for the Department is to integrate the potentialities of science into the formulation of foreign policy and foreign relations in such a way as to benefit all peoples and at the same time preserve the atmosphere essential to the progress of science and technology. Specifically, the science office and staffs would provide broad technical information and advice to the State Department and its embassies. The exchange of scientific information between countries would be fostered; international scientific organizations and meetings would be supported; visitation by foreign scientists and students invited; significant trends and developments in foreign science would be reported and encouragement given to private individuals and organizations to collect and transmit foreign technical information to the United States.

This Society, international in character and attitude, will applaud these proposals and look forward to their implementation. It is particularly timely as we plan to undertake, in President Truman's words, "a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas" that sound scientific advice and judgment be available to the State Department. While political considerations may well determine where the Point Four program shall be applied, scientific feasibility must be a controlling factor in determining what kind of projects shall be approved for foreign investment.

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Counterelectrodes for Selenium Rectifiers

A Review of the Literature[1]

Wm. B. Roberts

ABSTRACT

A brief history of the development of the selenium rectifier is given and its various components are treated in general. The counterelectrode is particularly emphasized and its function, application, and composition are dealt with in detail. References of particular interest relating to the foregoing are cited.

INTRODUCTION

The selenium rectifier as it is known today has largely evolved within the past two decades. The photoelectric effect of selenium was recognized as early as 1876 (1) and Fritts (2) constructed a successful photoelectric cell in 1883. This cell embodied the essentials of a selenium rectifier, and in 1917 Greinacher (3) reported the rectifying action of a selenium cell. The first reported commercially-available selenium rectifier appeared in Germany in 1928. This was credited largely to the efforts of Presser (4) who describes the construction of rectifiers in a series of patents (5–9). By 1935 the industry was well founded on the continent, as shown by the articles of Maier (10) and Koerber (11), and manufacture was undertaken in the United States in 1938. Selenium rectifier development and utilization was greatly accelerated both here and abroad during the war years, and today they enjoy wide and varied use. In spite of this, the manufacture of selenium rectifiers is still largely an empirical technique and a basic understanding of their construction, operation, and means of effecting rectification is yet to be achieved. This is graphically reflected in the literature which, though voluminous, is often contradictory and confusing.

It is not possible to point out any one component of selenium rectifiers as being more important than the others; the entire process is critical and must be subjected to the closest control if any measure of success is to be achieved. However, probably less attention has been directed toward the counterelectrode than to any other part of a rectifier and it is felt, therefore, that a brief review of the work accomplished to date in this field is indicated. Such a review will be given after the following general considerations which will serve to place the counterelectrode in its proper perspective relative to the whole rectifier.

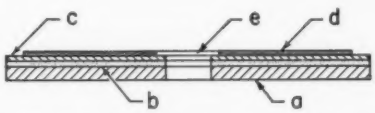


FIG. 1. Components of a selenium rectifier plate.

General Considerations

From a standpoint of appearance, the selenium rectifier is a deceptively simple device. As is shown in Fig. 1, it is usually thought of as consisting of four components, namely, the base plate (*a*), the selenium layer (*b*), the barrier layer (*c*), and the counterelectrode (*d*).

The selenium layer is sandwiched between a roughened base plate and another metallic film referred to as the counterelectrode. The base plate functions primarily as a rigid, electrically-conducting support for the selenium layer while the counterelectrode acts as the other electrical contact to the external circuit. Rectification is attributed to the presence of a barrier layer at the selenium-counterelectrode interface. The exact nature and characteristics of this barrier layer are still largely a matter of conjecture, but its presence may be assumed since selenium does not exhibit pronounced electrical asymmetry even in its "metallic" form. It is sufficient to say, at this point, that rectification is achieved as the result of a high resistance in the direction termed "reverse" coupled with a low resistance to current flow in the direction termed "forward."

Although there are several methods by which a satisfactory rectifier may be made, the following is one of the simplest. Vitreous selenium, containing a small amount of a halogen to improve conduction, is sprinkled onto an etched, nickel-plated aluminum base plate. This is then subjected to a pressure of from 1000 to 2000 psi at a temperature of between 100° and 150°C in order that the selenium may achieve sufficient plasticity to flow into a homogeneous film and make intimate contact with the base plate. The selenium is then given an additional heat treatment which serves to convert it into the so-called metallic[2], conducting state. The temperature of the annealing should preferably be in the neighborhood of, but less than, 218°C, the approximate melting point of selenium. However, it should not be less than 150°C or an excessive annealing time will be required. Subsequent to annealing, the selenium is usually given one of various chemical treatments designed to aid in barrier-layer formation. The counterelectrode is next applied by spraying; it consists of a relatively low-melting alloy, the bismuth-lead-cadmium eutectic being a typical example.

The rectifier is now mechanically complete, but it must be subjected to an electroforming treatment before it achieves its desired properties. This consists in applying to it a pulsating or other suitable voltage until the reverse resistance has increased to the point

[1] Manuscript presented before the Cleveland Meeting of the Society. Author's address: Physics Laboratory, Sylvania Electric Products Inc., P.O. Box 6, Bayside, L.I., New York.

[2] The crystalline, hexagonal allotrope. Although not strictly a metal, this modification will be referred to as metallic selenium in order to be consistent with the literature.

where adequate rectification is obtained; it is believed that the barrier layer is completed by this process. The final voltage employed in electroforming rectifiers is usually 5 or 10 volts above their a-c (rms) rated voltage and care must be taken that the temperature of the plates does not exceed the melting point of the counterelectrode. After standing for at least 24 hours to allow for the change in electrical characteristics that sometimes occurs, the plates are tested in both the forward and reverse directions. An oscilloscope circuit is preferred for this purpose as it gives a visual picture of the dynamic characteristics of the rectifier. The acceptable plates are then assembled on metal screws or spindles by means of a central hole (e) in each plate (see Fig. 1). Intervening metal washers serve to make contact between the plates and to allow air to circulate between them for cooling. Such a completed unit may be either a series or parallel arrangement (or both) and is referred to as a stack. The stacks are usually painted or varnished for protection and appearance.

THE COUNTERELECTRODE

The application of the counterelectrode is the final step in the mechanical completion of the rectifier unit and the counterelectrode itself consists of a metallic film applied to the exposed selenium surface. It functions as a contact to the external circuit and is usually composed of some low-melting alloy made up from such metals as bismuth, lead, tin, and cadmium. Although the counterelectrode is most often applied by spraying, reference will be made shortly to the other methods of application (mechanical pressing, cathodic sputtering, electrodeposition, and vacuum deposition) which have been discussed in the literature. Regardless of the manner by which it is deposited, the counterelectrode must, of course, be a good electrical conductor.

Application

In the event that the counterelectrode is sprayed, the metal or alloy employed should have a sufficiently low melting point to lend itself to the method and also to avoid melting the selenium when applied. On the other hand, its melting point must not be so low that it would melt at the temperatures employed in electroforming or at which the rectifier operates. These restrictions constitute the major disadvantages of the spray method of deposition.

The equipment used in the spray method is not particularly critical and a Schoop-type spray gun is considered by many to be adequate for the purpose; this technique is referred to specifically in patents by Blackburn (12, 13, 14), while many others, such as Thompson (15) specify "a spraying operation preferably effected by means of a suitable metallization pistol operated at a comparatively low pressure of approximately 30 psi." The Fiore pot gun is particularly well suited for counterelectrode application and experience has shown that the Shori powder gun is also adequate for the purpose. Irrespective of the type of gun employed, it should be fixed on a rack so that a relatively constant film thickness may be achieved by governing the time of pass and the distance from the work. Film thicknesses up to 0.005 inch are usually employed in commercial rectifiers in order that uniformity and continuity of the film may be assured (16); Wilson (17) refers specifically to a sprayed film 0.001 inch thick. It should be noted at this point that there is some evidence that rectifiers possessing thicker than usual (0.005 inch) counterelectrodes exhibit electrical characteristics superior to those with counterelectrodes of the usual thickness (18).

Application of the counterelectrode by mechanical pressing was employed in the early phases of rectifier manufacture, but seemed to suffer from the disadvantages of not achieving good adhesion to the selenium and the possibility of injuring the selenium film when applied. In a series of early patents, Presser (5, 7, 9) refers to a lead or bismuth counterelectrode to be pressed on mechanically, and Thompson and Jenkins (19, 20) state that either indium or thallium (or their alloys) counterelectrodes may be thus applied under considerable pressure. Many others refer to counterelectrode application by pressing; included among these are Osawa (21), Malmberg (22), and Sauerborn (23).

Application of the counterelectrode by vacuum evaporation and cathodic sputtering are mentioned in a British patent (24) where it is stated that such techniques result in extremely sensitive rectifiers and offer less chance of puncturing the selenium film. Lotz (25) also refers to vaporization in applying the counterelectrode, and Becker and Brattain (26) specify a pressure of less than 10^{-5} mm for the vacuum deposition of the counterelectrode in dry-contact rectifiers. A rather detailed discussion of cathodic sputtering as a means of applying the counterelectrode to selenium rectifiers is given by Berraz and Virasoro (27), while Christy (28), Lidow (29), Freivert and Berdnikov (30), Moldaver (31), and Preston (32) discuss the technique as utilized in the production of selenium photocells. Christy's specifications, which are more or less typical, call for an interelectrode resistance of 50–600 ohms and a gaseous pressure of 0.01 mm; although directed primarily at photocells, the process is probably adaptable to rectifiers.

An excellent discussion of metal film production by means of vacuum evaporation and cathodic sputtering appears in *Light Metals* (33) where the two processes are compared and specifications given. According to the foregoing reference, the evaporation technique is reported to be faster than cathodic sputtering and also permits finer control. It should be borne in mind that it is possible to deposit, by means of vacuum evaporation and cathodic sputtering, counterelectrode metals which could not feasibly be sprayed.

Electrodeposition of the counterelectrode is mentioned as a possibility by Escoffery (34), but no details concerning such a process seem to be available.

In summarizing the methods of counterelectrode application, it would seem that the spray technique is one of the most attractive. It is fast, easily controllable, and requires a minimum of equipment. Although vacuum deposition and cathodic sputtering permit a greater choice of metals and are less likely to result in puncture of the selenium film, they are not as well suited to commercial production as spraying and it seems hardly likely that they will replace the latter process. At the present time, counterelectrode application by cathodic sputtering and vaporization is mainly employed in photocell production and experimental work. As has already been mentioned, counterelectrode application by mechanical pressing would seem to be the least desirable of the methods noted.

Composition

Many metals and alloys have been employed as counterelectrode materials. Perhaps the most popular are the various alloys of bismuth, cadmium, tin and lead, along with the pure metals themselves. Some of the earlier Presser patents (5, 7, 9) specify a lead or bismuth counterelectrode, while Osawa (21) refers to one composed either of pewter (85% tin, 6.8% copper, 6%

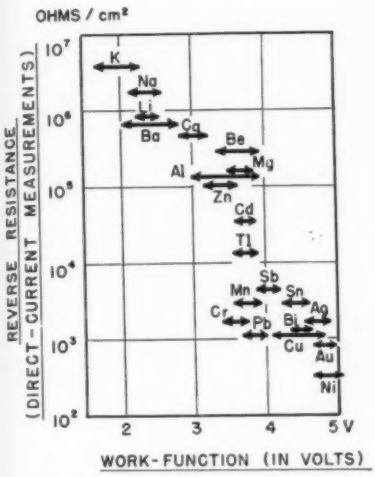


FIG. 2. Resistance in blocking direction of selenium rectifiers vs. work-function of metal (counterelectrode).

bismuth, 1.7% antimony) or a cadmium-tin alloy with a melting point of less than 220°C; others who mention the cadmium-tin alloys include Blackburn (12, 13, 35, 36), Wilson (37), Stateman (38), and Thompson (15). The compositions of the foregoing alloys vary roughly between 20–80 per cent tin and 70–80 per cent cadmium. Alloys of tin-bismuth-cadmium are specified by many including Ellis and Souden (39), Bloom (40), Saslaw (41), Van Amstel (42), and Goodman (43). These compositions are usually the eutectic alloy; 26 per cent tin, 53 per cent bismuth, and 21 per cent cadmium is specified. Counterelectrode alloys of pure cadmium have been mentioned (14, 25) as have metals "of the group comprising aluminum, antimony, nickel and bismuth" (44). Various low-melting alloys similar to the above and consisting of mixtures of lead, tin, bismuth, and cadmium are also listed by Henisch (45). The bismuth-cadmium eutectic is currently being used by some manufacturers in this country.

Manufacturing and laboratory experience have indicated that the composition and purity of the counterelectrode play an important role in the properties of the rectifier. Perhaps the first mention of this is made by Presser in a previously-cited patent (5) where it is stated that, "... the chemical nature of the electrode under pressure is of great importance in rectifiers having a rectifying layer containing selenium...." However, Bardeen (46) is of the opinion that the space-charge layer at the counter-electrode-selenium junction is independent of the metal and rectification characteristics are also independent of the metal. Both Schottky (47) and Schmidt (48) were able to establish a correlation between the reverse resistance of the rectifier and the counterelectrode metal work function and others have lent their support to this thesis (49). The indications are that as the work function of the metal decreases, the reverse resistance of the rectifier increases; Fig. 2 by Schweickert, taken from Joffe (50), indicates this relationship.

A patent by Thompson and Jenkins (51) is directed toward taking advantage of the properties of low-work-function counterelectrodes; they claim that a tin-cadmium counterelectrode containing 0.5 per cent sodium or potassium endows the rectifier with superior electrical properties. In order to obtain optimum results they also suggest the possibility of placing an intermediate counterelectrode of essentially pure sodium or potassium between the selenium and a counterelectrode of the usual type.

The dependence of the rectifier's electrical properties on counterelectrode composition finds further support in the work of Shive [reported by Bardeen (46)] who studied the rectification characteristics of a number of contacts made by evaporating metals onto the selenium. On the basis of this work, beryllium, zinc, lead, and gold are arranged in order of decreasing rectification. The work of Yamaguchi (52) indicates a similar relationship between counterelectrode composition and rectification. Williams and Thompson (53) state that as little as 0.01 per cent thallium in the counterelectrode practically doubles the voltage at which it may be operated safely. Thompson and Jenkins (20, 54, 55) are responsible for a series of patents dealing with a counterelectrode thus composed. Depending on the particular alloy involved, various quantities of thallium are specified, the limits being between 0.1 and 5.0 per cent. Fry (56) claims that the addition of up to 2 per cent magnesium to the counterelectrode (bismuth-tin-cadmium alloy) results in decreased reverse current and ability of the rectifier to withstand higher than usual a-c voltages without breakdown. It is stated that such additions make it possible to electroform units in less time because of the higher voltages and temperatures the rectifier will stand without breakdown.

It has been the writer's experience that, in addition to the foregoing, an increasing thallium content in the counterelectrode results in decreased current flow in both directions. Table I illustrates this point.

A similar effect is noted by Thompson and Jenkins (19) in a previously-cited patent where it is claimed that the addition of indium to the counterelectrode results in an improved rectification ratio (ratio of forward current to reverse current; in a theoretically perfect rectifier, the rectification ratio would be infinite).

The role played by the thallium, indium, and similar high-activity metals in this improvement is not clear, but it may be due to their relatively low work functions. It is possible that the ease with which low-work-function metals lose electrons is instrumental in decreasing the leakage and increasing the breakdown voltage. It should also be noted at this point that the addition of thallium (and perhaps similar metals) to the counterelectrode results in increased aging (57, 58) (i.e., an irreversible increase in both the forward and reverse resistance as a result of operation). This is the primary disadvantage of such additions.

TABLE I. *Variation in forward and reverse currents with increasing thallium*

Per cent thallium in counterelectrode	Mean forward current at 1.09 volts a-c (milliamperes)	Mean reverse current at 30 volts a-c (milliamperes)
0.021	93.3	171.0
0.042	67.7	139.5
0.063	32.0	91.0

The manner in which the counterelectrode is deposited on the selenium is also reported to effect to some degree the electrical properties of the rectifier.

Fig. 3, taken from Joffe (50), compares the capacitances of identically-made rectifiers, one having a gold-sputtered counterelectrode while the other has a gold counterelectrode applied by thermal evaporation. The curves indicate that the former rectifier exhibits a smaller capacitance[3] and

[3] The presence of an insulating layer between two electrodes (such as the barrier layer is assumed to be) causes the rectifier to exhibit a noticeable condenser effect at high voltages. This capacitance is a function of the current being passed through the rectifier and the applied voltage; it acts in a manner similar to a

Joffe attributes this result to the nonuniform distribution of impurity centers in its boundary layer. Assuming the validity of these results, it may be said that cathodic sputtering is a more desirable means of counterelectrode deposition than vacuum evaporation since the former technique obtains rectifiers with smaller capacitance effects.

SUMMARY

The following conclusions regarding the counterelectrode may be made:

1. Of the five methods by which the counterelectrode may be applied, that is, molten-metal spraying, vacuum evaporation, cathodic sputtering, mechanical pressing and electrodeposition, only the first and second mentioned are known to be employed to any extent in commercial rectifier production.

2. The molten-metal spraying method suffers from the disadvantage of temperature restrictions and only alloys with relatively low melting points can feasibly be applied by this method; care must also be taken that the selenium film is not punctured during the process. On the credit side, the method is said to be straightforward, economical and produces satisfactory rectifiers when properly carried out.

3. Cathodic sputtering, vacuum evaporation, or electrodeposition would overcome the disadvantages of metal spraying, but these processes do not seem to be easily adaptable to the production of films of the proper character. There are no indications in the literature that electrodeposition of the counterelectrode has been investigated, although the possibilities of this approach have been mentioned.

4. Application by mechanical pressing does not produce a good bond between the selenium and the counterelectrode. This technique also suffers from the disadvantage of being likely to puncture or deform the selenium film and is probably no longer employed industrially.

5. The evidence indicates that the composition of the counterelectrode exerts an appreciable influence on the electrical properties of the completed rectifier. On the basis of available information, it would seem that rectifiers with counterelectrode compositions involving metals of high activity (low work function) exhibit the most favorable blocking characteristics. The possibility that the method by which the counterelectrode is deposited influences the properties of the rectifier has also been mentioned, but additional work in this direction is necessary before any conclusions can be reached.

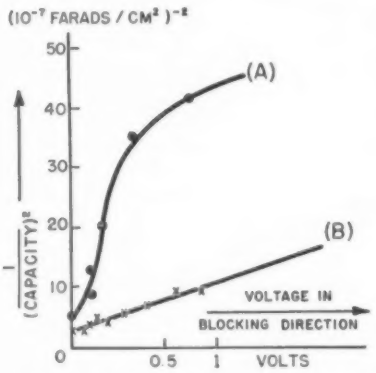


FIG. 3. Capacity of selenium rectifiers with gold counterelectrodes applied: (*a*) by sputtering, (*b*) by thermal evaporation.

small capacitor shunted across each plate. The capacitance results in lowering the impedance in reverse direction and its value is not constant, depending to a large degree upon the past history of the unit, applied voltage and frequency.

REFERENCES

1. W. G. ADAMS AND R. E. DAY, *Proc. Roy. Soc. London*, **25,** 113 (1876).
2. C. T. FRITTS, *Am. J. Sci.*, **26,** 465 (1883).
3. H. GREINACHER, *Arch. sci. phys. et nat.*, **44,** 472 (1917).
4. E. PRESSER, *Elektrotech. Z.*, **53,** 339 (1932).
5. E. PRESSER, German Pat. 501,228, June 30, 1930; U. S. Pat. 1,778,645, Oct. 14, 1930.
6. E. PRESSER, German Pat. 589,126, Dec. 12, 1933.
7. E. PRESSER, German Pat. 519,161, Feb. 25, 1931.
8. E. PRESSER, German Pat. 505,701, Sept. 10, 1930.
9. E. PRESSER, British Pat. 301,389, Dec. 6, 1927.
10. K. MAIER, *Elektrotech. Z.*, **55,** 221 (1934).
11. E. KOERBER, *Z. Ver. deut. Ing.*, **79,** 1415 (1935).
12. W. E. BLACKBURN, U. S. Pat. 2,484,204, Oct. 11, 1949.
13. W. E. BLACKBURN, U. S. Pat. 2,462,157, Feb. 22, 1949.
14. W. E. BLACKBURN, U. S. Pat. 2,447,630, Aug. 24, 1940.
15. L. E. THOMPSON, British Pat. 529,792, Nov. 28, 1940; U. S. Pat. 2,235,051, March 18, 1941.
16. *Light Metals*, **7,** 284 (1944).
17. E. D. WILSON, U. S. Pat. 2,479,446, Aug. 16, 1949.
18. Unpublished data. Research performed under the direction of Sylvania Electric Products Inc.
19. L. E. THOMPSON AND A. JENKINS, British Pat., 560,869, April 25, 1944; U. S. Pat. 2,380,880, July 31, 1945.
20. L. E. THOMPSON AND A. JENKINS, British Pat. 556,152, Sept. 22, 1943.
21. J. OSAWA, U. S. Pat. 2,124,306, July 19, 1938.
22. T. G. MALMBERG, U. S. Pat. 2,458,013, Jan. 4, 1949.
23. E. P. SAUERBORN, U. S. Pat. 2,462,906, March 1, 1949.
24. British Thomson-Houston Co., British Pat. 529,957, Dec. 2, 1940.
25. A. LOTZ, U. S. Pat. 2,121,603, June 21, 1938.
26. J. A. BECKER AND W. H. BRATTAIN, British Pat. 519,987, April 11, 1940.
27. G. BERRAZ AND E. VIRASORO, *Anales inst. invest. cient. y tecnol. Univ. nacl. litoral (Santa Fé, Arg.)*, **12-13,** 51 (1943).
28. A. CHRISTY, U. S. Pat. 2,066,611, Dec. 10, 1932.
29. E. LIDOW, U. S. Pat. 2,414,233, Jan. 14, 1947.
30. I. C. FRIEVERT AND N. B. BERNDNIKOV, *J. Tech. Phys. U.S.S.R.*, **7,** N13, 1333 (1937).
31. T. I. MOLDAVER, *C. A.*, **33,** 6728[8] (1939) [*Bull. acad. sci.* U.R.S.S., **5-6,** 705 (1938)].
32. J. S. PRESTON, *C. A.*, **31,** 5279[3] (1937) [*J. Inst. Elec. Engrs. London*, **79,** 424, (1936)].
33. *Light Metals*, **6,** 56 (1943).
34. C. A. ESCOFFERY, *Trans. Electrochem. Soc.*, **90,** 129 (1946).
35. W. E. BLACKBURN, U. S. Pat. 2,476,800, July 19, 1949.
36. W. E. BLACKBURN, U. S. Pat. 2,488,369, Nov. 15, 1949.
37. E. D. WILSON, U. S. Pat. 2,193,610, March 12, 1940.
38. M. J. STATEMAN, U. S. Pat. 2,462,917, March 1, 1949.
39. W. C. ELLIS AND A. G. SOUDEN, U. S. Pat. 2,362,545, Nov, 14, 1944.
40. M. C. BLOOM, U. S. Pat. 2,414,438, Jan. 21, 1947.
41. O. SASLAW, U. S. Pat. 2,433,402, Dec. 30, 1947.
42. J. J. A. P. VAN AMSTEL, U. S. Pat. 2,443,878, June 22, 1948.
43. M. GOODMAN, U. S. Pat. 2,481,739, Sept. 13, 1949.
44. H. ADENSTEDT, U. S. Pat. 2,246,161, June 7, 1941.
45. H. K. HENISCH, "Metal Rectifiers," p. 11, Oxford University Press, London (1949).
46. J. BARDEEN, *Phys. Rev.*, **71,** No. 10, 717 (1947).
47. W. SCHOTTKY, *Physik. Z.*, **41,** 570 (1940).
48. A. SCHMIDT, *Z. Physik*, **117,** 754 (1943).
49. J. E. TAYLOR, A. C. LYNCH, AND K. O. RICHARDS, Dept. Comm., P. B. #49209.
50. J. JOFFE, *Elec. Commun.*, **22,** No. 3, 217 (1945).

51. L. E. Thompson and A. Jenkins, U. S. Pat. 2,437,336, March 9, 1948.
52. J. Yamaguchi, *C. A.*, **42,** 44e (1948) [*J. Inst. Elec. Engrs. Japan*, **64,** 142 (1944)].
53. A. L. Williams and L. E. Thompson, *J. Inst. Elec. Engrs. London*, **88,** Part I, 353 (1941).
54. L. E. Thompson and A. Jenkins, U. S. Pat. 2,279,746, April 14, 1942; British Pat. 534,043, April 26, 1941.
55. L. E. Thompson and A. Jenkins, British Pat. 576,671, April 15, 1946.
56. S. S. Fry, U. S. Pat. 2,446,468, Aug. 3, 1948.
57. K. Lehovec, *C. A.*, **43,** 6925e (1949) [*Z. Physik*, **125,** 451 (1949)].
58. H. Dauber, Dept. Comm. P. B. #18781.

FUTURE MEETINGS
OF
The Electrochemical Society

Buffalo, October 11, 12, and 13, 1950

Sessions on

Batteries, Corrosion, Electrodeposition, and Electro-Organic Chemistry

Round Table on Electrothermics

Headquarters at the Statler Hotel

★ ★ ★

Washington, D. C., April 8, 9, 10, and 11, 1951

Sessions on

Electronics, Electrothermics, Electric Insulation, Luminescence,

Rare Metals, and Theoretical Electrochemistry

Round Table on Industrial Electrolytics

Headquarters at the Wardman Park Hotel

★ ★ ★

Detroit, Fall, 1951

Headquarters at the Statler Hotel

★ ★ ★

Philadelphia, Spring, 1952

★ ★ ★

Montreal, Fall, 1952

Authors are invited to submit papers now for the convention to be held in Washington. All manuscripts should be submitted in triplicate to the Editor of the Journal, 235 West 102nd Street, New York 25, N. Y.

Feature Section

The Society Looks at Itself in a Mirror

Presidential Address*

Alfred L. Ferguson†

For many years the condition of The Electrochemical Society and the part it has played in the field of electrochemistry have both interested and concerned me. At the meeting of the Board of Directors last October, the appointment of a "Committee for the Advancement of the Science and Profession of Electrochemistry" was authorized, including in its membership the President and the three Vice-Presidents. The work of the Committee thus far has involved the accumulation of information on the status of the Society from a variety of sources. Each of the living past Presidents and several others who have been prominent in the affairs of the Society were asked to comment on the following general topics:

(1) The basic principles of electrochemistry have found important applications in chemical engineering, metallurgy, biochemistry, and even in agriculture, botany, zoology, geology, and medicine, and yet the majority of the personnel employed in these fields have little or no academic training in electrochemistry.

(2) A large proportion of the personnel of electrochemical industries have had no special college work in electrochemistry.

(3) There is a lack of properly trained electrochemists to meet the requirements of industry, research organizations, and academic institutions.

(4) Both undergraduate and graduate students in our universities have little understanding of the importance of electrochemistry and the opportunities it offers scientifically and industrially.

(5) The importance of electrochemistry as a science and the magnitude of electrochemical industries are not appreciated by the administrative officials and the staffs of the chemistry departments of our colleges and universities.

(6) The personnel men of industrial employers who come to our universities seeking men appear to be unaware of the profession of electrochemistry.

(7) The Electrochemical Society and its publications do not enjoy as high a rating as they deserve among academic and industrial people.

(8) The Society should attract a larger proportion of the able men who are trained in electrochemistry.

(9) A majority of the best papers in the field of electrochemistry have appeared in publications other than those of the Society.

The comments on these topics by the past Presidents may be considered reflections which the Society sees when it takes a look in the mirror. I propose to present at this time statements taken from these replies expressing the recommendations of the authors, largely in their own words. First, let us see what the mirror has to say concerning the broad heading of membership.

The Society was founded in 1902 with 337 charter members. There was a steady increase in membership until it attained 2,279 in the year 1921. This was followed by a steady decrease in membership until 1936 when it had fallen to 1,156. From 1936 to 1942, the number remained static and since 1942 there has again been a steady increase of about 100 a year until the present figure of around 2,000 has been attained. In the words of a recent President: "The Society, when founded in 1902, had a wonderful opportunity to grow and develop with the electrochemical industries. Most of the early members were from the ranks of industry, but over the years we lost support in that quarter as papers became primarily academic in nature. Meanwhile other engineering societies attracted our industrial members."

Then to add the comments of another past President: "I am not so much concerned with the advancement of electrochemistry from a theoretical or academic standpoint as the use of its principles as applied to industry. A greater number of papers have been on theoretical subjects and consequently the meetings have been of less interest to industrial people. In the past the Society was run by a few people who seemed to be entirely satisfied. In view of the changes which have been made in recent years, I believe the condition of the Society will improve."

Still another past President has this to say: "I have tried hard to do something about the matter of placing The Electrochemical Society in better standing with regard to the consideration of the theories of electrochemistry and of raising the standing of its publications in the theoretical field. In that connection, I encountered active and passive opposition to all that I recommended. The problem is an old one. The first time I met Dr. Whitney, about thirty years ago, we discussed what could be done to raise the scientific standards of The Electrochemical Society."

Finally, a past President who represents the industrial research group and has been one of the most active and helpful members of the Society states his ideas as follows: "During one half of my twenty-eight years of membership, I have served in some official capacity and thus have had an opportunity to appraise the condition of the Society and its contributions to the profession of electrochemistry. The Society's fortunes and position were at the lowest ebb in the middle thirties. Our financial position was precarious; the management of the Society was not representa-

* Presented at the Cleveland Meeting, April 20, 1950.

† The author wishes to apologize to all who gave such thoughtful consideration to the questionnaire and offered excellent suggestions which, however, are omitted from this condensed form. Any person so desiring may secure a copy of the complete address by requesting one from the author.

tive; its meetings and publications were of interest mainly to a rather small group. Little emphasis was placed upon basic science, and industrial interest was confined to only a rather restricted part of the field. Even in the fields covered, such as electroplating, many who might have contributed were alienated. It is not surprising that survival of the Society was questionable."

That is the picture of the Society's affairs up to about 1944. As Dr. Burns has pointed out, "It was perhaps belief in or recognition of the fact that reasonably small societies, devoted to special fields of interest, are of importance in the advancement of these interests that led to a concentrated effort, by a group headed by Past President R. L. Baldwin, to introduce corrective measures. The steps taken were (a) establishment of sustaining memberships, (b) the stimulation of new fields of interest such as corrosion, dielectrics, electronics, electrolytic processes and batteries. Also the revision of the management structure of the Society by bringing representation of the various Divisions into the Board of Directors has made the management of the Society more representative."

It was seen that changes in management policies of the Society would be necessary and President Kirkpatrick appointed a committee of which past President H. S. Lukens was chairman to recommend changes in policies and procedures. The recommendations of this committee have been put into practice and were the basis of recent developments in the Society. A Ways and Means Committee was organized and under its first chairman, James A. Lee, was of considerable assistance in advising the President and Board. More recently under Dr. Hunter's effective leadership this Committee has continued to play a major part in studying and making recommendations on the changes proposed by the Lukens Committee.

Now let us look again into the mirror for reflections of the results of these developments in the structure of the organization. To quote further from one of the past Presidents: "I have been gratified to see a steady improvement in the affairs of the Society during recent years and many of the ideas that I have had and shared with others for the improvement of the Society have actually been adopted. I believe considerable progress has been made toward making the Society a more useful organization. We have adopted a modern method of publication with an attractive JOURNAL, and stimulated interest in meetings by encouraging the presentation of papers by the simple plan of accepting abstracts rather than approved and preprinted manuscripts."

A composite of the views of others is as follows:

"The new JOURNAL is meeting with general acceptance and will be an important element in enhancing the prestige of the Society. The prompt publication feature and the higher quality of papers now being published make it attractive to academic men. Plans should be made to increase the size of the JOURNAL. The Society and its publication provide an opportunity to serve both the science and industrial applications of electrochemistry."

The Local Sections should constitute one of the most valuable assets of the Society and the means whereby the membership may exert its greatest influence. It is here that real friendship should be developed. It is here where Society problems could be carefully studied. It is through these local groups that eligible nonmembers could be most easily procured and where discussions and contacts with those in the electrochemical field can be promoted. The Society should do everything possible to encourage the activity of Local Sections.

Finally, I should like to discuss a problem close to my profession as a university teacher of electrochemistry. For about thirty years I have given one lecture course in electrochemistry to our own graduate students, another which is more elementary and is a kind of service course for the other natural sciences, and finally a laboratory course open to both of these groups. The enrollment in the first runs between 40 and 50. A year ago I took a few minutes to tell the class something about electrochemistry as a profession and about The Electrochemical Society. It was a surprise even to me to learn that scarcely a member of the class had any idea that there is such a thing as an electrochemical profession and only a few had ever heard of the Society. Remember these were graduate students in chemistry, most of whom were working for the Ph.D. degree. They were taking the course because they realized its value in their own special fields.

About thirty years ago, the Society made a survey of the teaching of electrochemistry in universities. It was found that fourteen institutions were giving extensive work on the subject and most of them appeared to offer both graduate and undergraduate courses and to give degrees in electrochemistry or electrochemical engineering. In our recent questionnaire 120 colleges and universities have been included. They were asked to list the courses which are now offered. Replies were received from 103 of these schools and it appears that 45 of these offer one or more courses regularly and 18 of them provide laboratory work; however none of these institutions has a department of electrochemistry or grants a degree in this field. It was stated by some that courses had been offered previously, but the teacher had left or died and had not been replaced since in some instances a teacher was not to be found. Others stated that the field was too specialized or that the demand for electrochemical training had practically disappeared. These statements show that the heads even of the chemistry departments are not familiar with the real situation. It is up to this Society to accumulate the actual facts and inform these institutions of the true situation. We must see that industry actually creates a demand for such trained students or expresses a willingness to give priority to applicants who possess electrochemical qualifications.

The study of the Committee has shown that formerly there was too long a period between the submission of a paper and its publication in the TRANSACTIONS. Our present policy has corrected this situation. Some pointed out that the small circulation of the JOURNAL is a disadvantage. This objection will have less force as the quality and number of the papers in the JOURNAL become more important.

Other journals have been publishing a large number of electrochemical papers, only a few of which are by members of this Society. It is evident that there is much excellent research work in fundamental electrochemistry that is not published in our JOURNAL and is being done by authors who are not members of the Society. This constitutes a major challenge to our Society.

The statements which have been quoted in this address constitute the carefully considered judgments of the court of highest authority in the Society and should be so regarded by those who are now and who will be in the future active in determining the policies and activities of the Society. They may well serve as the basis for several round-table discussions and committee studies.

Buffalo Meeting Plans

Plans are now being completed for the ninety-eighth meeting of the Society, to be held at the Statler Hotel in Buffalo, October 11, 12, and 13, 1950. Technical sessions will begin Wednesday morning, October 11th, and run through Friday.

Registration

The registration desk will be open Wednesday from 8:30 A.M. to 9:00 P.M.; Thursday, 8:00 A.M. to 5:00 P.M.; Friday, 8:30 A.M. to 5:00 P.M.

Registration fees for the meeting will be as follows:

Members	$6.00
Ladies	2.00
Students	1.00
Other nonmembers	8.00

At the meeting of the Board of Directors, held July 8th, it was voted that if a nonmember registering at a convention fills out an application blank and pays his first year's dues, the difference between the nonmember and member registration fee shall be applied to his dues, if he is elected.

Technical Program

The varied technical program will be of interest to all members. The Electrodeposition Division will present four symposia, including sessions on cleaning and evaluation. To date, the Corrosion Division has scheduled four sessions, one of which will be devoted to the measurement and interpretation of electrode potentials and other electrical properties of metals in relation to corrosion processes. The Battery Division is scheduling comprehensive programs on dry cells and wet cells, and the Electro-Organic Division will offer papers covering the latest research in its field. As an added attraction to the technical program, the Electrothermic Division is sponsoring a round-table discussion on nonferrous metal-melting and nonmetal furnaces. (See below).

Plant Trips

Dr. W. C. Gardiner and his committee have planned an outstanding program of plant trips. The plants to be visited have been selected with primary regard to providing subjects of electrochemical interest. Details are described on page 190*C* of this issue.

W. C. GARDINER

Chairman, Plant Visits Committee

Luncheons and Dinners

On Wednesday evening, the members and guests will be welcomed by the Local Committee at a cocktail party, informal dinner, and special entertainment.

Plans for Thursday include a luncheon dedicated to the memory of the late past president Raymond R. Ridgway, and the Acheson banquet in the evening.

The luncheon hour on Friday is open for group luncheons, which may be arranged directly with the hotel management by chairmen or secretaries (elected or self-appointed) of the groups. Correspondence should be addressed to Mr. J. R. Hewett, Sales Manager, Hotel Statler, Buffalo, New York.

For additional information about the Buffalo program, please refer to recent issues of the JOURNAL: June, page 127*C*, July, page 153*C*, August, page 171*C*. The detailed program for the meeting will appear in the October issue.

Round Table on Electric Furnace Operation

It has been decided that the round-table discussion which is scheduled for the meeting in Buffalo this October will be held on Wednesday, October 11th, in two sessions. In one of these it is planned to cover the field of Nonferrous Metal Melting and in the other the field of Nonmetal Furnaces.

Mr. G. J. Easter, who is organizing the program, is very anxious to have advance listing of subjects which will be of interest to our members and also suggestions as to particularly qualified persons that you feel might make worthwhile contributions to the program. If you have anything to offer along either of these lines, please send your suggestions to:

Mr. G. J. Easter
Electro Refractories & Alloys Corporation
Willett Road
Buffalo 19, New York

Remember that these round tables are "off the record" and that their success depends entirely on the participation of interested people who are there. This meeting is for you. Tell us what you want discussed and who you think knows the most about it. Also, if you know something worth passing along, don't keep it secret but let Mr. Easter know that you would be willing to trade your idea for another one.

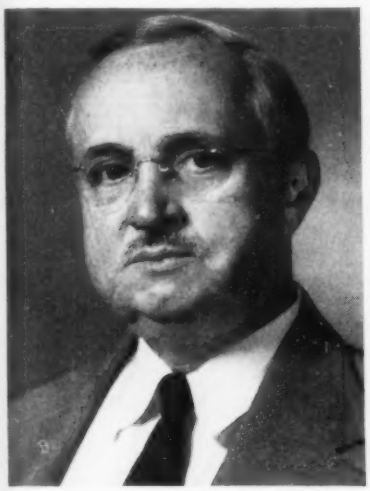
G.J.E.

George W. Vinal Chosen Acheson Medallist

Award to be Made in Buffalo

Dr. George W. Vinal, Chief of the National Bureau of Standards' Division of Electrochemistry and Dean of the NBS staff, has been selected as the eleventh recipient of the Edward Goodrich Acheson Medal and Prize. The choice was announced by the Board of Directors of The Electrochemical Society after its meeting in New York on July 8th. The award, a gold medal and $1,000 prize, conferred biennially, is for the most outstanding contribution in the fields of activity fostered by the Society. It will be presented to Dr. Vinal at a banquet in his honor during the fall meeting of the Society in Buffalo.

Dr. Vinal's distinguished career includes 42 years of service on the staff of the National Bureau of Standards, in the Electrical Division. In addition, he has been Chief of the Division of Electrochemistry since its establishment in 1918. He retired from active service at the Bureau in July, 1950.



GEORGE W. VINAL

Dr. Vinal is a long-time member of The Electrochemical Society, having joined in 1923. He was vice-president in 1930–32, was the first chairman of the Battery Division, and has served on numerous Society committees. Other professional societies to which he belongs are the American Association for the Advancement of Science, the American Chemical Society, American Institute of Electrical Engineers, Cosmos Club, National Geographic Society, Philosophical Society of Washington, and the Washington Academy of Sciences of which he was vice-president in 1931.

George Wood Vinal was born in Ellington, Connecticut, on December 17, 1882. He received his A.B. degree in 1906, M.A. in 1909, and honorary degree of D.Sc. in 1936 from Wesleyan University. He was first employed by the Bureau of Standards in the summer of 1904 in connection with the St. Louis Exposition, returning the following summer to assist in the determination of the emf, and permanently joining the staff July 1, 1908.

He has been active in the establishment of the values for the international volt and ampere, and as a result has published a number of papers on the silver voltameter. He has had world-wide recognition as an authority on standard cells, and in primary and secondary battery fields.

Dry and storage batteries were a focus of interest during World War I, and the progress and extent of Dr. Vinal's work in these fields are indicated in part by the publications, some 25 in number, by him and his associates. This work includes qualification tests for dry cells, special performance tests of storage batteries, specifications for battery purchases, and a ready source of information on battery problems. He has written two authoritative texts: "Storage Batteries," published in 1924 which has been revised twice and translated into French, and "Primary Batteries," released in June 1950.

The many honors conferred upon Dr. Vinal attest to the esteem in which he is held by his associates. Included are: Phi Beta Kappa, Wesleyan University, 1934; Gaston Planté Medal de la Société Francaise d'Electricité presented by the French ambassador, 1938; Certificate of the office of Scientific Research and Development, 1945; Certificate of Commendation, Bureau of Ships, Navy Department, 1947; Medal for Meritorious Service, Department of Commerce, 1949.

Aside from his professional duties Dr. Vinal has served on important committees of the American Standards Association, Federal Specifications Board, Society of Automotive Engineers, National Research Council, Research and Development Board, and as delegate to the eighth American Scientific Congress in 1940.

Lecturers Named for Corrosion Course at Case

The short course in corrosion to be given at the Case Institute of Technology under the direction of Dr. R. B. Hoxeng, on September 25–29, will include 9 lecture periods of 2 to 2½ hours each plus time for discussion. There will be two lectures daily except Friday.

Authorities in the field who will lecture on corrosion and corrosion prevention are F. L. LaQue, International Nickel Co., Inc., New York; Dr. R. B. Mears, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.; H. A. Robinson, The Dow Chemical Company, Midland, Mich.; Dr. Mars G. Fontana, Ohio State University, Columbus, Ohio, and Professors W. von Fischer, E. G. Bobalek, and R. B. Hoxeng of Case Institute.

$27,000,000 Company for Mathieson-Tennessee Gas

Arrangements have been completed for the organization of a new $27,000,000 company to be known as the Mathieson Hydrocarbon Chemical Corporation, according to a recent announcement by the president of Mathieson Chemical Corporation, Baltimore, Maryland.

The new company is a joint enterprise of Mathieson Chemical Corporation and the shareholders of Tennessee Gas Transmission Company. The company will produce a number of chemicals from hydrocarbons contained in the natural gas stream transported by Tennessee over its pipeline network from Texas and Louisiana fields to the northern and eastern markets.

More than 2,000 acres of land have been acquired near Brandenburg, Kentucky, and chemical units costing $17,000,000 are to be constructed there. It is expected they will be completed by the end of 1951.

At the same time, it was announced that Tennessee Gas Transmission Company is building a $12,000,000 stripping plant near Greensburg, Kentucky, which will separate the hydrocarbons from the natural gas stream, and a pipeline will be constructed to bring them to the new Hydrocarbon Chemical plants.

Officers of the new company have been elected as follows: Thomas S. Nichols, president; John C. Leppart, executive vice-president; Russell Hopkinson, administrative vice-president; Carl F. Prutton, vice-president, operations; and S. deJ. Osborne, treasurer and secretary.

Buffalo Plans Extensive Plant-Trip Program

The falls of the Niagara River have played a dual role in making the Niagara Frontier an area of special significance and interest to the electrochemical and related industries. Long before the possibility of hydroelectric power was realized, the Niagara Falls formed a natural barrier, necessitating a break in the continuity of water transportation between the upper Great Lakes and the Atlantic seaboard. Here, where water-borne cargoes had to be unloaded and transported overland or transferred to barges for the Erie canal, it was natural to build storage facilities and processing plants to be fed by the raw materials funneling into the lake port and from which the products could be distributed economically over a large populated area. Later, with the advent of the electric generator, there was discovered here a reservoir of energy from which power could be developed in greater quantity and with better continuity than from any other natural source in the country.

It was inevitable, then, that the electrochemical industry should come first to this region, where power, raw materials, and markets already existed, that it should be followed by other industries that fed this industry or used its products.

The plants to which trips will be offered in connection with the Buffalo meeting represent various manifestations of this natural tendency. The Westinghouse motor plant is an example of a supplier that came to the market. The Buffalo Electro-Chemical Company and the new Lionite Abrasives Plant require electrical energy for their processes. The rayon and cellophane operations of Du Pont enjoy the advantage of proximity to suppliers of electrolytic caustic soda, as well as cheap water transportation of cellulose pulp. Colonial Radio utilizes the supply of skilled electrical labor that is inevitably associated with the specialized industrial development of the region. And last, the tremendous steam-driven generating facilities of the Huntley Station were called into existence to keep generating capacity in step with the demand, which has far surpassed the output of the hydroelectric development.

Becco Rectifier Installation

Of the various German technical developments reported since the war, one of the most interesting to the electrochemical industry is the contact rectifier. This machine is a radical departure from previously used means of rectification, and the early reports on its performance and on the means used to prevent rapid destruction of the contacts by sparking taxed the credulity of many American engineers.

The first American industrial installation of the contact rectifier was, therefore, an act of courage; and it was natural that it should have been undertaken by the same company that installed the first mercury arc rectifiers to be used in the electrochemical industry.

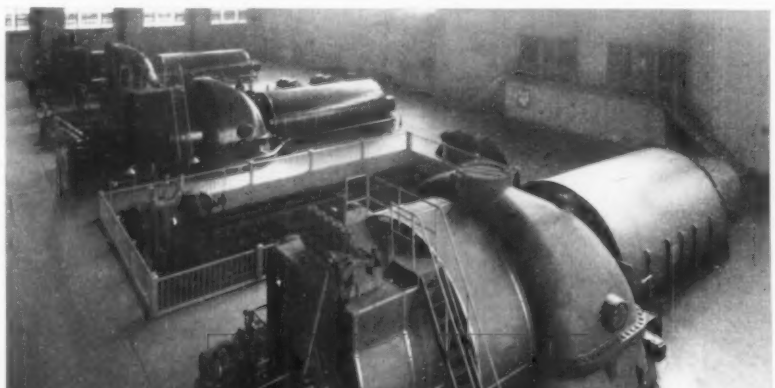
The installation at the plant of the Buffalo Electro-Chemical Company operates on an input of 25-cycle alternating current at 11,000 volts, and has a rated output of 3500-amperes direct current at 280 volts. It is capable, however, of continuous operation at 50 per cent overload, and has been operating consistently with an output between 4500 and 5000 amperes with a conversion efficiency above 95 per cent.

By the time of the meeting, the machine will have been modified to incorporate the latest improvements in design, including provision for changing the contact timing without interrupting operation.

The Becco installation furnishes an exceptional opportunity for comparison of rectification equipment, since it comprises other types, including motor generator sets and modern mercury arc rectifiers, as well as the original mercury arc pots, which are still operating.

Huntley Generating Station

The American equivalent of "carrying coals to Newcastle" would seem to be realized in sending electric power to Niagara Falls. Nevertheless, the demand for electric energy in the Niagara industrial area has long since surpassed the amount that can be produced by the maximum diversion of water permissible under the international treaty. Consequently, the construction of steam electric facilities at the Huntley Station was started as long ago as 1916. Since that time, the plant capacity has been increased until it is now one of the largest steam electric stations in the world.



THREE 80,000-KILOWATT GENERATORS AT HUNTLEY STATION

The Charles R. Huntley Station of the Niagara Mohawk Power Corporation is located on the east bank of the Niagara river just north of Buffalo, where coal can be delivered either by boat or by rail, and where there is a plentiful supply of cooling water for the condensers. When the station is operated at full capacity, it requires more than a hundred carloads of coal and over a billion gallons of cooling water per day.

The first generators installed were 25-cycle, like those of the hydroelectric plants at Niagara Falls; and generating capacity at that frequency was gradually expanded until 1930, when the addition of the seventh generator brought the capacity of 25-cycle output to 305,000 kw. In that same year,

four 60-cycle generators with a total capacity of 160,000 kw were installed; and subsequent expansion has all been at the latter frequency.

In recent years, the trend has been toward larger generators, larger boilers, and higher pressures. The last two units, installed in 1942 and 1948, represent the latest development in this direction. Each of these units has a rated capacity of 80,000 kw, with a permissible overload of 25 per cent, bringing the total capability to 100,000 kw per unit. Each turbo-generator is driven by steam from a single boiler at 1250 psi.

The total rated capacity of the station is now 625,000 kw, thereby contributing a very substantial percentage to the generating capacity of the Niagara Mohawk system, which has a total of over 2,000,000 kw, distributed among 81 hydro plants and six steam plants.

New Lionite Abrasives Plant

The new Canadian plant of Lionite Abrasives, Ltd., a subsidiary of General Abrasive Company, was completed early this year. However, power was available only on week-ends until the first of July when full production began.

This is a one-product plant producing silicon carbide in resistance furnaces. It is unusual in being very highly mechanized in handling and mixing operations. Additional mechanical equipment is still being installed. The electrical equipment includes transformers which automatically step down in voltage under load to maintain constant power input as the initial high voltage decreases.

Yerkes Cellophane Plant

The Yerkes Cellophane Plant, along with several other Du Pont plants and offices, is located just outside the Buffalo city limits. This was the first plant for the production of Cellophane and was started in 1924, shortly after Du Pont secured the American manufacturing rights. In 1927, Du Pont chemists succeeded in developing the moisture-proofing process and 90 per cent of present production is moisture-proof Cellophane.

The Buffalo location provides employment to approximately 2800 people with an annual payroll in excess of seven million dollars. There is an investment of more than $10,000 for each workman, and fifteen million dollars is spent yearly for material, coal, machinery, etc.

The Du Pont Company cannot allow competitors on the inspection trip and it is requested that the trip registration list with corporate affiliations be in Du Pont hands before the trip.

Colonial Radio and Television

The Colonial plant has had a varied history in equipment manufacture. It was originally a sewing machine and milk separator plant which changed to radio about 1930. It became a division of Sylvania five years ago and added television to its radio production.

The plant will be of interest to a widely varied group. The stream-line assembly of radio and television sets will be seen on conveyor systems. There are an elaborate electronics department and a paint-and lacquer-finishes department. In addition there is an electroplating plant which furnishes a part of the electroplating requirements for the Buffalo plant.

Although television is founded on the existing radio industry, there were many problems to solve before assembly-line practices could be applied. Changes are under way in the present television assembly system which should be complete before the inspection-trip date.

Westinghouse Motor and Control Plant

This plant, built originally as a war-time aircraft plant, now stands as an example of how the American electrical equipment industry has solved the problem of continuing economical production in the face of rising labor costs. The building, covering 55 acres, was purchased by Westinghouse at the end of the war, and converted for the production of motors and industrial controls. The annual output is valued at about $74,000,000, or about $12,000 for each of the 6,246 employees.

The two main divisions of the plant are devoted to production of integral horsepower motors and to industrial control equipment. The motors range in size from 1 to 700 hp ratings at 3600 rpm, and include all types—single phase, polyphase, and direct current. The operations include, however, the manufacture of selenium and copper oxide rectifiers, and all types of electric welding equipment.

One of the interesting features of the plant is the wire manufacturing operation, in which copper wire for use by all of the divisions of Westinghouse is drawn and insulated.

The tour will cover all of the manufacturing operations.

From Volta to Vanadium—

the facts you need on

PRIMARY BATTERIES

By GEORGE WOOD VINAL
National Bureau of Standards,
Author of *Storage Batteries*

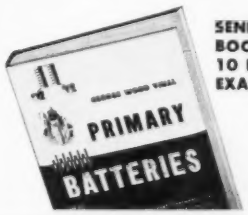
For the first time in 35 years, a man with wide experience in the field has written a down-to-earth book covering the whole field of primary batteries. This specialized treatment offers a wide range of information—History, Chemical reactions, Theory, Manufacture, Materials and Operating characteristics

The Latest on Special Batteries

Much recent data are revealed, derived from the use of new research tools such as the electron microscope, x-ray spectrograph, mass spectrograph, and the petrographic microscope. Covered for the first time in their modern forms in any book are several new types of special-purpose batteries. Included are batteries for operating at low temperatures, for giving large currents, for producing more energy per unit of weight, and those which remain inactive until required for use. Practical detailed material is presented on silver oxide and chloride batteries, mercury oxide batteries, and perchloric and fluoboric acid batteries.

Practical Data on Standard Cells

Of particular value to those dealing with precise electrical measurements is the thorough chapter on standard cells (standards of emf). Among other aspects it gives history, a general discussion, preparation, assembly, intercomparing emf's, and temperature control.
June 1950 336 pages $5.00



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G-E's Turbine Production in 1949 Equals 1948 High

During 1949, the General Electric Company produced 2,797,500 kilowatts of fuel-fired electric generating capacity for the nation's electric utilities, according to a recent announcement. This equipment is enough to provide electric power for six million people.

This production, says Glenn B. Warren, manager of the General Electric Turbine Divisions, equalled the output of G-E plants in 1948, which previously had been the highest in the company's history. The Turbine Divisions accomplished the twin task of maintaining high production while moving manufacturing facilities into the new $30,000,000 turbine plant, largest postwar factory building in the U. S. Mr. Warren predicted that the company's expanded manufacturing facilities would enable General Electric to produce more than three million kilowatts of generating capacity for electric utilities in 1950, thereby surpassing previous records.

Included in the 1949 shipments were turbine generators ranging in size from 10,000 to 150,000 kilowatts. These machines incorporate design and engineering features which will enable U. S. electric utilities to produce more power with less fuel. Also, during the year the company built and installed the nation's only mercury-unit power plant for industrial use at the G-E Pittsfield, Mass., plant.

The Turbine Divisions likewise completed the country's first gas-turbine power plant for use in an electric power generating station. Installed in a plant of a southwestern utility, the equipment has operated successfully for more than 3023 hours and has generated in excess of eleven and one-half million kilowatt-hours of electricity.

Monsanto Plans Largest Phosphorus Furnace

The Monsanto Chemical Company plans to construct the sixth electric furnace for the production of elemental phosphorus at Monsanto, Tennessee, according to an announcement from the company office at St. Louis, Missouri.

The new furnace which will have a capacity of 25,000 kw, will be the largest phosphorus furnace in the world and one of the largest electric furnaces ever built. This furnace will enable the company to bring about a sizeable increase in the production of phosphorus. It is expected to be completed in January, 1951.

The work at the plant in Monsanto, Tennessee, consists of mining and processing phosphate rock and converting it into yellow phosphorus.

New Phosphorus Plant for Victor Chemical

The construction of an electric furnace plant at Silver Bow, near Butte, Montana, was approved at a recent meeting of the Board of Directors of Victor Chemical Works, Chicago, Illinois. Construction is to begin at once.

The plant will manufacture elemental phosphorus from phosphate rock drawn from nearby deposits. The location of the plant, and the selection of the mines, are the result of a long-time investigation by engineers and chemists of Victor. The company now operates phosphorus plants in Tennessee and Florida, and four other plants for the processing of phosphorus in Illinois, Tennessee, Pennsylvania, and California.

National Academy of Sciences to Meet at G-E

The National Academy of Sciences will hold its autumn meeting at the new quarters of the General Electric Research Laboratory near Schenectady, N. Y. The meeting will begin on Monday afternoon, October 9th and extend through Wednesday, October 11th. This will be the first time in the Academy's 88-year history that their sessions have been held at an industrial laboratory.

Technical sessions will start on Tuesday morning; Wednesday afternoon will be devoted to inspection trips through the various laboratory buildings. A feature of the meeting will be a public lecture, on Tuesday evening, at Union College, by Dr. Cornelius P. Rhoads, Director of Memorial Hospital Center for Cancer and Allied Diseases, in New York, as well as of the Sloan-Kettering Institute associated with it. He will describe the scientific work now being done on cancer.

AIEE Combines Summer -Pacific Meeting

The American Institute of Electrical Engineers combined its 1950 Summer and Pacific General Meeting, holding the joint convention at Pasadena, California, on June 12th to 16th. As this is California's centennial year, unusual opportunities for entertainment supplementing the technical features were offered.

The Huntington Hotel in Pasadena was headquarters for the meeting and the California Institute of Technology, also at Pasadena, housed some of the student members.

The technical program extended from Monday through Friday and covered sessions on Electronics, Transmission and Distribution, Computors, Transformers, Safety and Protective Devices, Instruments and Measurements, Microwave Applications, Hydroelectric Systems, the Bevatron, and other topics. In all, about 150 papers were presented.

The inspection trips were equally interesting as the area presents a variety of outstanding industries. Included on the AIEE agenda were visits to Lockheed Aircraft Corporation, Walt Disney Studios, Southern California Edison Company's Redondo Steam Station, Mount Wilson Observatory, Kaiser Steel Corporation, and others.

Forum on Corrosion Research

The "Review of 'Forum on Corrosion Research' held at Washington, D. C., November 9–10, 1949," which appeared in the April 1950 issue of the JOURNAL, pages 83C–91C, is now available in the form of a more detailed report containing digests of the papers presented. Requests for copies of this report should be addressed to the Materials Branch, Office of Naval Research, Washington, D. C.

FUTURE MEETINGS OF OTHER ORGANIZATIONS

INSTRUMENT SOCIETY OF AMERICA CONFERENCE & EXHIBIT, Memorial Auditorium, Buffalo, New York, September 18–22

NATIONAL ELECTRONICS CONFERENCE, Chicago, Illinois, September 25–27

AMERICAN GAS ASSOCIATION, annual convention, Atlantic City, New Jersey, October 2–6

INTERNATIONAL ASSOCIATION OF ELECTRICAL LEAGUES, 15th Annual Conference, Copley Plaza, Boston, Massachusetts, October 11–14

38TH NATIONAL SAFETY CONGRESS & EXPOSITION OF THE NATIONAL SAFETY COUNCIL, Chicago, Illinois, October 16–20

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION, annual convention, Hotel Biltmore, Los Angeles, California, October 17–20

DIVISION NEWS

Battery Division

Dr. George W. Vinal, Chairman of the Nominating Committee of the Battery Division, has submitted the report of the committee presenting the nominees for the fall election. Other members of his committee are R. W. Irwin and L. E. Lighton. The election, for a two-year term, will be held in October, 1950, during the Buffalo Meeting of the Society. The slate announced is as follows:

Chairman—J. N. Mrgudich, Winchester Repeating Arms Company
Vice-Chairman—E. F. Willihnganz, National Battery Company
Secretary-Treasurer—U. B. Thomas, Bell Telephone Laboratories
Members-at-Large of the Executive Committee—E. A. Schumacher, National Carbon Company; J. C. White, Naval Research Laboratory.

Attention is called to the provision of the By-Laws that additional nominations may be made by any member of the Division either in writing to the Secretary-Treasurer of the Division or from the floor at the business meeting. Such additional nominations should carry assurance of the nominees' willingness to serve.

U. B. Thomas, *Secretary-Treasurer*

SECTION NEWS

Midland Section

The Midland Section of the Society held its final meeting of the 1949–50 season on June 15th in the White Birch Hills club-house, near Bay City. A considerable number of the attending members enjoyed nine holes of golf before the dinner meeting.

Following the dinner a business meeting was held at which the local section officers named below were elected:

Chairman—F. W. Koerker
Vice-Chairman—H. A. Robinson
Secretary-Treasurer—H. H. Roth

The various committees then reported on the activities of the past year.

Dr. R. M. Hunter addressed the gathering, discussing the needs and aspirations of The Electrochemical Society at the national level.

H. H. Roth, *Secretary-Treasurer*

PERSONAL

H. V. K. Udupa has returned to India where he resides at Handady Village, South Kanara District, Madras. He had been at Ohio State University, Columbus, Ohio, and received his Ph.D. degree in electro-organic chemistry in June.

Frank L. LaQue of International Nickel Company, Inc., New York has been selected as the Society's representative to the Research Council on the Causes and Methods of Prevention of Internal Corrosion of Water Pipes.

Norman Hackerman, of the University of Texas, at Austin, has been appointed chairman of the technical program committee for the 1951 Conference and Exhibition of the National Association of Corrosion Engineers to be held in New York next spring, March 13–16.

Fred Peters of Reinhold Publishing Corporation, New York, and Dennis R. Turner of Westinghouse Research Laboratories, East Pittsburgh, have been appointed to serve on the membership committee of the Society.

Matam P. Murti, formerly of the Industries and Commerce Department of the Government of Madras, and a Government of India student in electrochemical engineering in the United States is now at the National Bureau of Standards, Washington, D. C. He received his M.A. degree in chemical engineering at the Case Institute of Technology, Cleveland, Ohio.

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BOOK REVIEW

THE PHYSICAL CHEMISTRY OF ELECTROLYTIC SOLUTIONS, new 2nd edition, by Herbert S. Harned and Benton B. Owen. American Chemical Society Monograph No. 95, published by Reinhold Publishing Corp., New York, 1950. 650 pages, $10.00.

It is an old story, but one worth repeating, that the study of solutions of electrolytes, with which the subject of physical chemistry started, was almost completely dead as far as significant research was concerned when suddenly it got a shot in the arm by the appearance, in 1923, of the paper by Debye and Hückel on the interionic attraction theory. Only those who have lived and worked with electrolytic theory before and after that date can appreciate the stimulus to scientific circulation produced by the appearance of a new and exciting theory. To chemists this paper, and those which followed, were not easy reading since they bristled with mathematical symbols but those who wanted to keep up with the times found they had to develop the necessary mathematical understanding. That the interionic attraction theory is essentially right, or more strictly speaking, useful, has been shown by innumerable researches designed to test it. The influence of the theory has reached from physical chemistry to such subjects as biology, geology and oceanography, and indirectly into industry.

Probably nobody has read all the papers and books directly concerned with the Debye-Hückel theory. However, the authors of the book under review have possibly come as near to it as anybody. They have, in addition, brought order and system into the subject. Few people who have not undertaken a similar project can appreciate the enormous labor of collecting references, study, computation, and recomputation involved in the production of a work of this kind. It is a tribute to the book, to the authors, and to the scientific public, that a second edition of the book is required after only six years. It has evidently found its place as a text and as an invaluable reference book.

The fact that both of the authors are active research workers, and not simply book compilers, shows on nearly every page. They are accustomed to taking the crude ore of experimental data and working it up into the precious metal of scientific conclusions. In fact a large, but not too large, part of the book deals with experimental work carried out in the Yale laboratories. This background of contact with experiment has enabled the authors to weigh adequately the results of other workers. In this process the investigations of, for instance, the reviewer and his associates at the Rockefeller Institute have come in for keen and knowing criticism.

To list even the subjects treated in this book of 650 pages would take more space than is usually accorded for a review. It must suffice to say that solutions of electrolytes are considered from the points of view of thermodynamics, irreversible processes (diffusion and conductivity), ion association, and thermochemical quantities. Comprehensive as it is, the book does not cover the whole field. For instance, the kinetics of reactions involving electrolytes and ionic entropies are not included.

The revision involved in the second edition consists largely in two appendixes. The first of these brings up to date the values of conductances, transference numbers, standard potentials, etc. This will save other workers much computation and bibliographical effort.

The second appendix, which deals with theory, should help the reader to get in touch with recent advances in the rapidly growing field of solutions of electrolytes. It contains, for instance, an account of the conductance method for determining the coefficients of diffusion of salts developed at Yale since the appearance of the book.

Two features which characterize the book are the wealth of references to the literature and the careful indexing. An unfortunate tendency, evident in too many textbooks and treatises appearing at the present time, is the grudging acknowledgement of credit to those who did the experimental work on which the scientific conclusions are based, making it difficult for a reader to go to the original sources of the information. The practice can have the effect of drying up the sources of pure science research, since workers in such fields are paid largely in recognition. The present work excels in its references to the original work and in the indexing of subjects and names.

Quite in the spirit of the rest of the book is the inscription: "To those institutions which have fostered free inquiry through these troubled times, this book is gratefully dedicated."

D. A. MACINNES

ANNOUNCEMENTS FROM PUBLISHERS

ELECTRONIC TIME MEASUREMENTS edited by B. Chance, R. I. Hulsizer, E. F. MacNichol, Jr., and F. C. Williams. Published by McGraw-Hill Book Company, Inc., New York, 1949. 538 pages, $7.00.

This book presents the method of approach to problems of time and space measurements by manual and automatic means, and the practical circuits employed for these purposes. It includes the characteristics of displays and cursors, tracking methods, fixed indices for manual time measurements, etc. Also the basic techniques and methods in pulse time measurements, the delay line and circuit considerations in driving line.

PLASTICITY OF CRYSTALS by E. Schmid and W. Boas. Translation from the German published by F. A. Hughes & Company, Inc., London, 1950. 369 pages, 35 shillings.

The contents are as follows: (I) Some Fundamentals of Crystallography, (II) Elasticity of Crystals, (III) Production of Crystals, (IV) Determination of the Orientation of Crystals, (V) Geometry of the Mechanisms of Crystal Deformation, (VI) Plasticity and Strength of Metal Crystals, (VII) Plasticity and Strength of Ionic Crystals, (VIII) Theories of Crystal Plasticity and Crystal Strength, and (IX) The Properties of Polycrystalline Technical Materials in Relation to the Behaviour of the Single Crystal.

PROGRESS IN BIOCHEMISTRY by Felix Haurowitz. Published by Interscience Publishers, New York, 1950. 410 pages, $7.50.

This book is a report on biochemical problems and research since 1939. It is intended to be read from cover to cover. The main portion deals with the biochemistry of the organic and inorganic body constituents and with their metabolism, as related to humans and animals. Biologically active substances from molds, bacteria, and plants are briefly treated; also muscle contraction and nervous excitation, immunochemistry, and laboratory methods. Recent advances are discussed including chapters on "intermolecular forces in living matter" and "thermodynamics and kinetics."

NEW MEMBERS

At the meeting of the Board of Directors held on July 8, 1950, at the office of The Electrochemical Society, Inc., 235 West 102nd Street, New York City, the following were elected to membership:

Active Members

ARTHUR E. CARLSON, General Chemical Division, Allied Chemical & Dye Corp., mailing add: 53 Selvage Avenue, West Englewood, New Jersey (Electrodeposition)

LYLE W. EVANS, Sylvania Electric Products Inc., Seneca Falls, New York (Electronics)

RICHARD C. EVANS, Catalyst Research Corp., mailing add: 1527 Northwick Road, Baltimore 18, Maryland (Theoretical Electrochemistry)

EDITH B. FEHR, General Electric Company, mailing add: Cayuga Road, R.D. 1, Schenectady, New York (Electronics)

SAMUEL S. FREY, Oakite Products, Inc., 22 Thames Street, New York 6, New York (Electrodeposition)

RALPH E. FRIEDRICH, Physical Research Laboratory, The Dow Chemical Company, Midland, Michigan (Electronics and Electro-Organic)

Reinstatements

ANTON W. HOSIG, National Carbon Division, Union Carbide & Carbon Corp., mailing add: 1623 Linwood Avenue, Niagara Falls, New York (Electrothermic and Industrial Electrolytic)

VERNER V. KENDALL, National Tube Co., P. O. Box 266, Pittsburgh 30, Pennsylvania (Corrosion)

Student Associate Member

ARTHUR J. KERBECEK, JR., Columbia University, mailing add: Glenwood Landing, Long Island, New York (Electrodeposition)

RECENT PATENTS

Selected for electrochemists by Fred. W. Dodson, Chairman of the Patent Committee, from the Official Gazette.

April 11, 1950

Cain, J. R., 2,503,234, Method of Making Electrolytic Iron

Cain, J. R., 2,503,235, Method of Electrodeposition of Iron

Shore, L. G., 2,503,302, Geiger Counter

(Continued on page 196C)

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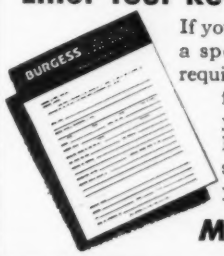

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MEMBERS:

. . . . A Convention Cruise?

Members who enjoy Electrochemical Society meetings will be interested to learn that, in response to many requests, tentative plans are being made to combine the Fall 1952 Convention in Montreal with a cruise on the famous Saguenay River. As an added attraction to the technical sessions and entertainment aboard ship, there will be stopovers at unusual points of interest along the way, including a day at Arvida, center of the largest electrochemical operation in the world.

Preliminary figures from the Canada Steamship Lines set the cost for the complete trip, including all meals, at $65.00, which is little more than you pay for hotel and meals when attending a meeting in any large city. The boat will leave Montreal at 7 P.M. EST, Wednesday, September 24, 1952, and return to Montreal at 6 A.M. Sunday, September 28.

Your help is needed before the cruise can be scheduled. Arrangements must be made in the near future to reserve a ship for the exclusive use of the Society, but before final commitments are made, we must have assurance from the members that the meeting will be well attended.

The Board of Directors has requested that those who plan to take the trip make a deposit of $25.00 so that an estimate may be made of the number who will attend. It will be necessary to have 300 reservations by December 1, 1950. If there is insufficient response, the trip will not be scheduled and the deposit will be returned.

If you would like to take this cruise, please send your deposit *promptly*, together with any suggestions you may have, to the Secretary of the Society, Dr. Henry B. Linford. The address is 235 West 102nd Street, New York 25, N. Y.

Thanks for helping us plan this 102nd Convention!

Recent Patents

(*Continued from page 195C*)

and Gas Atmosphere Therefor

Hirsh, B. W., and Carter, C., 2,503,337, Electrolytic Cells of the Liquid Electrode Type

Griffith, D. L., and Rankin, M. J., 2,503,479, Removal of Impurities from Zinc Electrolyte Solutions

Hamilton, J. H., 2,503,617, Electrical Precipitator

Lindner, R. L., and Hayes, T. K., 2,503,621, Induction Furnace

Yule, J. A. C., 2,503,790, Fluorescent Coloring Materials

Bart, S. G., 2,503,863, Apparatus for Electroplating the Inside of Pipes

Rupp, J. L., 2,503,970, Storage Battery Grid

Becker, A. H., 2,503,992, Inner Tube Tester

Unschuld, H. M., and Alther, J. G., 2,504,058, Process of Removing Sulfur from Oils

Vedensky, D., 2,504,095, Electrolyzing of Chrome Solutions to Recover Chrome

April 18, 1950

Burnham, J., and Green, G. E., 2,504,178, Electrical Condenser.

Rau, D. W., and Bruemmer, A. H., 2,504,226, Devices which have Selenium as Constituent Parts Thereof

Wesley, A., 2,504,238, Anode Assembly

Roehl, E. J., 2,504,239, Nickel Plating

McCoy, E. H., 2,504,272, Electrodeposition of Silver

Wardell, R. W., 2,504,288, Liquid Level Indicator for Storage Batteries

Lincoln, R. L., 2,504,430, Electrostatic Precipitator

Mason, R. B., 2,504,434, Forming Oxide Coatings on Aluminum

Brownshield, M. L., 2,504,493, Piezoelectric Cell

Reid, A. F., 2,504,585, Cyclotron Target

White, C. C., 2,504,608, Woven Synthetic Resin Storage Battery Retainer With Ribs

Benzer, S., 2,504,627, Electrical Device with Germanium Alloys

Benzer, S., 2,504,628, Electrical Device with Germanium Alloys

Fonda, G. R., 2,504,674, Luminescent Material

Vollrath, J. P., 2,504,764, Thermocouple with Wire Insulation

Johnson, L. L., 2,504,840, Tilting Induction Furnace

MacKenzie, K. W., 2,504,858, Electrical Precipitator

Siegert, A. J. F., and Watt, B. E.,

2,504,888, Radioactive Borehole Logging
Tremblay, B. G., 2,504,906, Composite Metal Electric Contact Member
Morris, A., 2,504,935, Copper Base Alloy and Conductor and Manufacture Thereof

April 25, 1950

Terlizzi, P. M., and Saitta, V. F., 2,505,014, Dry Cell Having a Plastic Case
Sachs, C. C., and Bond, J., 2,505,067, Catalytic Photopolymerization Process and Compositions
Sachs, C. C., and Bond, J., 2,505,068, Catalytic Photopolymerization Process and Compositions
Georgiev, A. M., and Campbell, J. J., 2,505,180, Electrolyte
Riggs, H. C., 2,505,207, Nonspill Storage Battery
Chase, B. L., 2,505,228, Silver Cleaning Device
Deprez, C., and Basilewsky, A., 2,505,466, Plant for the Electrolysis of Alkali Salt Solutions
Ellwood, W. B., 2,505,531, Magnetic Jig for Electroplating
Leverenz, H. W., 2,505,621, Zinc Cadmium Sulfoselenide Phosphors

May 2, 1950

Goller, G. N., 2,505,762, Stainless Steel and Method
Goller, G. N., 2,505,763, Stainless Steel and Method
Goller, G. N., 2,505,764, Stainless Steel and Method
Kaufman, J. M. S., Krasnow, S., and Schaerfl, J. A., 2,505,776, Method of Manufacture of Hollow Floats of Thin Metal for Ship Compasses
Moore, H. R., 2,505,785, Method of Producing a Corrosion Inhibitive Coating on Ferrous Metals
Richardson, R. P., and Lewis, R. W., 2,505,835, Flat Primary Dry Cell
Baker, G. L., 2,505,876, Electric Storage Battery
Patai, I., Bishop, H. R., administrator of said Patai, I., deceased, 2,505,909, Cathode-Ray Tube with Oxide Coated Cathode
Behn, E. R., 2,505,936, Temperature Compensated Conductivity Cell Electrode
Morse, J. E., 2,506,164, Method for the Production of Metallic Printing Members
Buckley, J. J., 2,506,340, Apparatus for Charging Batteries
Smoluchowski, R., 2,506,393, Method for Producing Material with High Magnetostrictive Properties
Greiner, E. S., 2,506,420, Cobalt Base Alloys and Resistance Elements Formed Therefrom
Whitaker, G. C., 2,506,438, Electrolytic Process for Production of Fluorine
Patai, I., Bishop, H. R., administrator of said Patai, I., deceased, 2,506,466, Electron Emitters
Wright, A. V., 2,506,478, Instrument for Testing Paper
Goller, G. N., 2,506,558, Stainless Steel and Method

May 9, 1950

der Mateosian, E., 2,506,582, Electrolytic Polishing of Metals
Woolley, H. W., 2,506,625, Photoelectric Cell
Kennedy, J. M., Knight, A. P., and Lee, H. J., 2,506,794, Apparatus for Electroplating
Doughty, L. A., 2,506,952, Closure for Storage Batteries
Dittmer, J. C., 2,507,096, Process for the Electrolytic Refining of Lead or Lead Alloys Containing Bismuth
Verwey, E. J. W., 2,507,233, Electric Resistance and Method of Making
Howatt, G. N., 2,507,253, Stabilization of Sensitivity of Metallic Titanate Piezoelectric Elements
De Marinis, F., 2,507,400, Method of Electroplating with Iron and Cobalt
Lloyd, R. R., 2,507,475, Electrodeposition of Chromium
Lloyd, R. R., 2,507,476, Electrodeposition of Chromium

May 16, 1950

Cohen, S. J., 2,507,490, Centrifugal Apparatus and Method for Effecting Chemical Reactions
Price, R. E., 2,507,645, Method for the Electrical Determination of Sulfuric Acid Concentration
Cox, G. C., 2,507,694, Immersion Anode
Claassen, H. H., 2,507,770, Transducer for Ultrasonic Waves
Farber, E., 2,507,773, Process for Treating Wooden Battery Separators
Goodman, M., 2,507,782, Rectifiers
Oechsner, J. G., 2,507,811, Battery Protector
Hefti, H. R., and Kolb, W., 2,507,973, Electrolytic Reduction of Sugars
Adam, W., Jr., 2,508,004, Electric Salt Bath Furnace
Lemmers, E., 2,508,118, Starting Strip for Electric Discharge Devices
Hein, C. C., and Stevenhagen, J. W., 2,508,161, Rectifier Element
Kaufman, L. W., 2,508,171, Electrode Construction
Whittaker, C. C., 2,508,205, Temperature Indicating Device

NOTES FROM INDUSTRY

Personalities

INTERNATIONAL GRAPHITE AND ELECTRODE CORPORATION, St. Marys, Pa., has announced the following appointments: JOHN W. LOHNES to Vice-President in Charge of Carbon and Graphite Sales for Speer Carbon Company, and its subsidiary, International Graphite and Electrode Corporation; WILLIAM E. HARVEY to Plant Manager of all carbon and graphite plants of the parent company, Speer Carbon Company, and its subsidiaries; ROBERT E. RICE to Sales Manager of International Graphite and Electrode Corporation, St. Marys.

CHAS. PFIZER & COMPANY, INC. of Brooklyn has announced the appointment of A. C. Finlay as Assistant Director of the Biochemical Research and Production Division. New research personnel who have recently joined the Biochemical Research and Production Division at Pfizer include J. F. Snell, Richard N. Shoemaker, Arthur R. English, and Samuel C. Beesch.

HORIZONS INCORPORATED of Cleveland has added Dr. Jacob L. Snoek, noted Dutch scientist and physicist, to its physics department staff. Dr. Snoek's special interests are in the fields of magnetic metals and oxides which are being used in television, radio, and telephony.

ALUMINUM COMPANY OF AMERICA has named A. H. Schmeltz as manager of its newly established Patent Department. John M. Mitchell has been appointed manager of Alcoa's Export Division, and G. B. D. Peterson has been named head of the Division's New York office.

KENT R. VAN HORN became Associate Director of Research for Aluminum Company of America at New Kensington, Pa., on August 1st.

ALFRED C. LINDQUIST has been named Manager for Sound Products Sales and associated electronic activities of RCA Engineering Products Department, Radio Corporation of America, Camden, N. J.

MONSANTO CHEMICALS LIMITED of London recently announced the appointment of two new members, Professor E. K. Rideal and Granville

Tyser, to the Board of Directors. Professor Rideal formerly was Fullerian Professor of Chemistry and Director of the Davy-Faraday Research Laboratory, Royal Institution of Great Britain. He is past president of the Faraday Society and Society of Chemical Industry. Mr. Tyser is a former managing director of Lazard Bros. & Company Ltd., and is a director of a number of important British concerns.

Products

GENERAL SCIENTIFIC EQUIPMENT COMPANY, Philadelphia, has available an improved Jackson's face shield, type J-1, especially deisnged for metal finishing, welding, wood working, etc. The

improved headgear is of plastic, fitted with sweat band and pivot assembly. Visor is fire-repellent, flexible, and comes in three thicknesses and depths. Shield and visor are adjustable to requirements of the user.

CORNING GLASS WORKS, Corning, N. Y., recently demonstrated their new E-C (electrically conducting) glass. This glass has a transparent skin that conducts electricity, but resists enough to heat the glass up to 660° F. The skin is a metallic oxide only about 16 millionths of an inch thick. Currently, heaters made of flat panels of this glass are being used for such service as textile drying, lacquer drying, paper coating treatment, and chicken brooding. In addition, a percolator made with an E-C heating element on the bottom of the glass bowl is now in development—and other household appliances are expected to follow.

"LITTLE GIANT" ELECTRON MICROSCOPE is a new model dramatically reduced in size, complexity, and cost, announced by RCA Victor Division of Radio Corporation of America, Camden, N. J. The new instrument, standing only 30 inches high, is expected to sell for less than $6,000. It provides useful magnifications up to 50,000 diameters

by photographic enlargement, with direct magnification in the instrument ranging up to 6,000 diameters. It has a 50,000-volt accelerating potential and is said to be 20 times as powerful as the best optical microscope, with a depth of focus 150 times as great. RCA expects the new microscope to greatly broaden the applications of electron microscopy, especially to metallography, bacteriology, and medicine.

GLYCO PRODUCTS COMPANY, INC., Brooklyn, N. Y., offers two products for making improved Di-phase metal cleaners. Added to the solvent which is used in combination with water, a simple but efficient cleaner with good detergency is obtained. Not heated, thus avoiding toxic fumes, fire hazards, etc. Samples and directions for use available upon request.

Publications

CASTALOY LABORATORY APPLIANCES is a new 24-page booklet published jointly by Fisher Scientific Company, Pittsburgh, and Eimer & Amend, New York, to describe the companies' line of modern laboratory hardware. The booklet presents "Castaloy" holders, clamps, and supports for holding laboratory equipment and assemblies. Copies are available, free to laboratories.

EMIL GREINER COMPANY has recently published an illustrated four-page bulletin describing the firm's Cartesian Manostat #6, covering development, construction, operation, and application. The instrument is designed for automatic vacuum and pressure control in industry, pilot plant, and laboratory. The bulletin (CM 97) may be obtained from James W. Fishel, Fairfax Advertising Agency, 551 Fifth Avenue, New York 17, N. Y.

GENERAL ELECTRIC RESEARCH LABORATORY has prepared an unusual chart giving information on more than a thousand kinds of atoms. A copy with an accompanying explanatory booklet will be mailed free. Requests should be sent to Dept. 6-221, General Electric Company, Schenectady 5, N. Y.

FANSTEEL METALLURGICAL CORPORATION, North Chicago, Ill., has released Technical Data Bulletin 4.303, detailing methods and procedures for forming and fabricating molybdenum. Instructions are given for forming, punching, shearing, drawing, spinning, heating, annealing, brazing, welding, cleaning, etching, grit blasting, and hydrogen firing. Copies supplied upon request.

BUEHLER LTD., 165 W. Wacker Drive, Chicago 1, Illinois, has released a bulletin featuring AB Surfacers and Grinders. Complete descriptions and illustrations of models are given. The bulletin is available on request.

EMPLOYMENT SITUATIONS

Position Available

RESEARCH ASSOCIATE of American Electroplaters' Society to work at National Bureau of Standards on permeability and protective value of electroplated coatings. College graduate with at least two years experience, preferably in electrochemistry. Salary $4000 to $5000 per year. Application should include qualifications and minimum acceptable salary. *Reply to Box A-217.*

Position Wanted

ELECTROCHEMIST, M.Sc., experienced mainly in batteries and allied fields with responsible positions in research development, product engineering, production engineering, sales engineering, and administration. Publications and patents. Desires position of responsibility in development manufacturing or sales engineering. Available on one month notice. *Reply to Box 341.*

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